University of Alberta

Assessing the Relationship Between Regulation Style, Affect and Exercise Adherence or Dropout

by

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Abstract

The overall purpose of this study was to examine the relationships between self-determination and exercise-related affect between exercise adherers, non-adherers and dropouts. Eighty-eight women (mean age 24.36) participated in an 11-week exercise program. They completed measures of motivation, affect and attendance at the beginning, middle and end of the program. It was found that attendance was negatively predicted at time two by the introjected self-determination subscale, suggesting that less self-determination is associated with worse attendance. Affect levels before, during and after exercise sessions did not significantly predict attendance. Affect was related to motivation, however. There were significant positive relationships between positive affect and identified and intrinsic regulation, and between negative affect and external and introjected regulation. The relationship between motivation and attendance was not be mediated by attendance. The major findings support the association between motivation style and exercise affect posited by self-determination theory.

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ASSESSING THE RELATIONSHIP BETWEEN REGULATION STYLE, AFFECT AND EXERCISE ADHERENCE OR DROPOUT

Introduction

The issue of physical inactivity is a major problem in our society. Recent data have shown that 43% of the Canadian population is considered to be sedentary (Carron, Hausenblas & Estabrooks, 2003). In addition, approximately 50% of sedentary adults who begin exercise programs dropout within six months (Dishman, 1994). It is extremely important to determine the factors that lead people to drop out or to adhere to exercise programs. These findings would ultimately assist in decreasing the prevalence of sedentary behavior in the population. Two factors that are considered to be important influences on behavior are motivation and affect experienced during exercise. Self-determination theory (SDT) provides a framework for assessing how motivation styles relate to exercise behaviors and it has been used successfully in many contexts (Ryan & Deci, 2000). Affective states associated with exercise have also commonly been related to exercise behaviors (Parfitt, Rose & Markland, 2000). However, the combined influence of motivation style and affect on subsequent exercise behavior has rarely been examined. This study considers the influence of each of these two factors on exercise behavior as well as on each other. Different types of motivation, referred to as motivational styles are likely to be associated with different affective states.

Literature Review

Understanding and increasing levels of exercise participation has been a major focus of research in exercise psychology. Learning about the processes by which individuals become motivated to adopt and maintain a physically active lifestyle represents a significant challenge to the field of exercise psychology (Markland, 1999).

This literature review will focus on how motivation and affect have been used in exercise psychology to predict physical activity behavior and exercise adherence/dropout. Some exercise adherence literature proposes that enjoyment and intrinsic motivation are important elements in the adoption and maintenance of habitual exercise programs (Lutz, Lochbaum & Turnbow, 2002). Intuitively, there is a connection between affect, motivation, and exercise participation. However, motivation and affect have rarely been studied together in studies addressing adherence to or dropout from exercise programs. Consequently, exploratory research should be conducted to learn more about how these variables are related to exercise behaviors. Additionally, factors related to dropout have rarely been studied. If factors related to dropout could be determined, this information could be used to decrease the rate of dropout from exercise programs. Information regarding motivation, affect, and exercise adherence/dropout could potentially lead to effective exercise interventions that would serve to increase levels of physical activity

Motivational Style

Self-determination theory (SDT) is a theory of human motivation (Ryan & Deci, 2000) that has frequently been applied to study exercise behaviors. SDT assumes that people are motivated to satisfy three basic needs of autonomy, competence, and relatedness (Biddle, Soos, & Chatzisarantis, 1999). When these three needs are satisfied, a state of enhanced self-motivation results (Ryan & Deci, 2000). Many theories still define motivation as a unitary phenomenon (Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003). However, SDT postulates that there are different types of motivation that range on a self-determination continuum. Extrinsic motivation is represented by four regulatory styles, ranging from least to most self-determined: external, introjected,

identified, and integrated regulation. Intrinsic motivation is the most self-determined type of motivation, and is defined as the inherent tendency to seek out novelty and challenges, to enhance one's capacities, and to explore and to learn. Externally regulated behaviors are performed to satisfy an external demand or to achieve a reward. Behaviors underpinned by introjected regulation are performed to avoid guilt and anxiety, or to increase pride. Identified regulation occurs when the behavior is accepted or seen to be personally important. Integrated regulation occurs when a behavior is fully assimilated to the self. In other words the behavior has been brought into congruence with one's values and needs (Ryan & Deci, 2000; Biddle, Soos, & Chatzisarantis, 1999).

Research in this field has demonstrated that SDT is a useful theory for understanding how different types of motivation are related exercise behaviors. More self-determined exercise regulations have been found to positively relate to exercise behavior, attitudes, and physical fitness (Wilson, Rodgers, Blanchard & Gisell, 2003). It also has been shown that exercise intentions are best predicted by more self-determined forms of motivation. For example, Biddle et. al., (1999) predicted exercise intentions from external, introjected, identified, and intrinsic exercise regulations. Extrinsic regulation was found to be negatively correlated with intention. Identified and intrinsic regulation showed positive correlations with intention. In another study, Wilson and Rodgers (2003) predicted intentions using SDT and found that identified and intrinsic regulations were more strongly correlated with exercise intentions. Evidently, when a behavior is motivated by internal (identified and intrinsic) rather than external factors, intentions are more likely to be formed. However, these studies do not describe how these intentions lead to sustained exercise behavior. It should be determined if self-

determination can be used as a predictor of exercise program attendance and physical activity level. Also, the majority of studies do not examine changes in motivational style over time. Examining the typical pattern of motivation over time may be useful in determining critical periods during an exercise program where individuals may feel less motivated and could be likely to drop out.

It is clear that motivational style is related to maintenance of exercise and to psychological outcomes. When exercise is more intrinsically motivated, the associated affect is more positive, thus leading to increased participation and higher perceived competence (Frederick, Morrison & Manning, 1996). These findings suggest that motivation, affect, and exercise participation are closely linked. These relationships should be examined further to determine how these three variables are related.

It appears that certain motivation styles are more strongly related to behavioral intentions to exercise. One possible mechanism through which motivational style influences exercise intentions and behavior might be the affective experience of the exercise. When the motivation for intentions to perform behaviors is more internal, affective states associated with performing that behavior might be more positive. The experience of more positive affect might, in turn, result in more sustained exercise behavior.

Affect

There is a lack of consistency in observed relationships between exercise and affect. It is often assumed that exercise improves mood. However, both positive and negative affective states have been associated with exercise. Studies have shown that exercise has immediate anxiety-reducing and mood enhancing effects (Sexton, Sogaard

& Olstand, 2001). Lane, Crone-Grant and Lane (2002) assessed affect before and after various resistance training sessions. They reported that exercise significantly reduced depression scores but also increased fatigue scores. There is also research that supports that when it is too difficult, exercise is associated with negative affect. There have not been any studies examining the long-term influence of affective experiences during exercise with exercise adherence.

Positive affective states have been associated with intrinsic motivations and better psychological well-being (Maltby & Day, 2001). Vitality, a form of positive affect, has been found to contribute to a sense of well-being as do the components of SDT (Ryan & La Guardia, 2000; McAuley, Talbot & Martinez, 1999). It seems possible then that since positive affect is a potential outcome of exercise that the motivational regulation underpinning the exercise behavior might be associated with the affective outcomes.

Affect and Intensity of Exercise

Affective responses to physical activity are believed to have a corresponding physiological origin (Tuson & Sinyor, 1993). Basically, positive affect has been shown to be related to the intensity of exercise bouts or sessions. It has been suggested that endorphins released during exercise result in elevated mood states and that endorphins are only released at relatively high exercise intensities. In turn, these elevated mood states lead to reinforced exercise participation (Klonoff, Annechild & Landrine, 1994). The measurement of affect along with physiological measures such as, heart rate or VO_2, might lead to more accurate association of affect with exercise as all subjects could be assessed at the same physiological marks. This would allow for comparison between groups and individuals based on physiological markers. For example, beginners to

exercise and more advanced exercisers could be compared on their affective states at 70% of their maximum heart rates. However, more research is required to determine how physiological variables influence psychological responses to exercise (Lutz, et. al., 2002). It is not clear, for example, whether perceived exertion levels are the more critical influences on affect compared to actual intensity of exercise determined by the physiological markers.

Hardy and Rejeski (1989), studied relations between intensity level and affect and found that ratings of perceived exertion (RPE) were related to responses on the Feeling Scale (FS), however the nature of the relationship was not consistent. Both positive and negative relationships were found between positive affect and exercise intensity, and negative affect and exercise intensity. These relationships only existed at easy or hard workloads, not moderate, and they were inconsistent. As metabolic demands increased, the RPEs had a stronger relationship with physiologic cues (such as VO_2 max) than affective states (Hardy & Rejeski, 1989). This suggests that the relationship between affect and intensity is not very clear, even though these relationships existed there was no pattern to the relationships.

The affective responses of trained and untrained subjects were examined during and after aerobic exercise to assess this relationship between intensity level and affect (Boutcher, McAuley & Courneya, 1997). The Positive and Negative Affect Scale and Feeling Scale were used to assess affect, and heart rate was monitored. The trained participants showed increased positive affect during moderate and hard intensity exercise compared to baseline. The untrained participants however, showed decreased positive affect after exercise compared to baseline (Boutcher, et. al., 1997). These findings are

consistent with Gaynor, Markland, and Holmes (1994). They reported that highly active individuals (male and female) had significantly more positive affect in the 90% VO_2 workload condition than the low active individuals. However, there was no difference between the groups at the 60% VO_2 workload condition. This dose-response intensity effect on affective states has been seen in other studies (Petruzzello & Tate, 1997). These findings suggest that when untrained individuals work at intensities that are difficult for them they may experience negative affective states. Thus, the workloads that are likely to produce positive affective states need to be adjusted in view of the fitness level of participants.

Hall, Ekkekakis, and Petruzzello (2002) examined the relationship between affective states, intensity level and exercise adherence. Affect was assessed before, during, and after exercise at different percentages of aerobic capacity (VO_2 sub max). It was determined that exercise intensities that required a transition to anaerobic metabolism had a substantial negative impact on affect. They postulated that this negative affect might reduce adherence to exercise programs. These findings show that intensities that are too high for an individual can lead to negative affect. This suggests that when beginners start an exercise program they should not work at very high intensities as it might lead to negative affect and possibly drop out. Working at intensities that are too difficult for a beginner might lead to negative affective states and might also make the individual less self-determined for exercise. Determining the relationship between intensity level and affect would be useful to determine the levels of intensity likely to produce the most positive affect.

Measurement of Affect

The issue of affect measurement must also be considered. Concerns regarding the instruments used and timing of affect measurement must be addressed. The measurement and construct validity of some measures of affect used in sport and exercise contexts are still unknown. Also, it is unclear how and when affect should be measured (Crocker, 1997). The findings of many studies are difficult to compare due the discrepancies in methods and procedures used to assess affect (Steinberg, et al., 1998). Clearly, however, the timing of the measurement of affect must be aligned with the physiological demands of the exercise.

There are many ways to assess affective change, for example, from the beginning of the session to the end, middle to the end, and end to a given amount of time after the session has ended. Some studies have measured affect before and after a session. Others have measured affect during the exercise session. It is unknown whether it is the change in affect over an exercise session, or the peak affect experienced during the workout that is the more effective predictor of exercise adherence. Perhaps affect should be assessed before, after and during exercise to ensure that all emotional states surrounding the exercise session are examined within individuals.

The instrument used to assess affect will depend on the timing of the affect measurements. If affect is assessed before and after the exercise session, a longer instrument such as the Positive and Negative Affect Scale (PANAS) would be appropriate as it provides information on 20 items and takes more time to fill out. The participant can focus on answering more questions as they will not be exercising during the administration of this instrument. However, if affect is being assessed during the

session, the Feeling Scale (FS) would be much more appropriate as it is only a single-item measure, and would not distract the participant too much from exercise itself. Clearly, the timing of the measurement of affect will influence the decision of what measure to use.

Affect, Motivation, and Exercise Adherence/Dropout

The constructs affect and motivation have rarely been studied together with exercise adherence and dropout. In one of the few studies, Frederick, Morrison, and Manning (1996) hypothesized that intrinsic motivation toward exercise would heighten positive affect, and therefore, lead to increased participation. It was found that more self-determined forms of motivation predicted affect but not adherence to exercise. However, extrinsic motivation positively predicted adherence, but for men only. Two studies by Lutz, et. al., (2002) also examined how self-determined motivation related to affective responses in exercise contexts. Self-determined forms of motivation for exercise correlated positively with positive affect and external regulation and amotivation for exercise correlated negatively with positive affect. However, these results were not obtained from actual exercise sessions. Participants engaged in an imagery session where they imagined exercising at a desired intensity. Participants completed the PANAS at the end of the imagery session. The second study used actual exercise sessions to overcome the weakness of the first study. Affect was assessed in aerobics class participants before, immediately after, and 15 minutes after the class ended. Relative autonomy significantly predicted post-exercise positive affect, and delayed post-exercise affect. These two studies support the association between motivation style and affective states. These findings should be extended by examining the effects of motivation and affect on

adherence/dropout from actual exercise programs. Whether affect mediates the relationship between self-determined motivation and exercise participation remains to be studied (Lutz, et al., 2002). In addition, there are no known studies that identify variables that distinguish among adherers, non-adherers, and dropouts. This would be extremely useful information as it would help to identify those at risk of dropout opening up the possibility of developing interventions to prevent dropout.

Overall, there is evidence that motivational style is associated with adherence to exercise. Affect is also associated with adherence to exercise. However, the relationship between motivation style and affect is not as clear. This is likely because few studies have examined the influence of motivational variables on affective responses to exercise (Lutz, et. al., 2002). Studies should be conducted to further explore the relationship between motivation and affect. It would also be beneficial to determine if affect mediates the relationship between motivation style and adherence/dropout from exercise programs. This would allow practitioners to better predict those at risk of drop out and create effective interventions.

Limitations of the Research

Some major limitations exist in the literature reviewed. Many studies aim to predict exercise intentions only and do not attempt to predict actual behavior. Of the research that does try to predict behavior, the majority attempts to predict adherence to exercise. Predictors of dropout have rarely been studied. If predictors of dropout could be determined, health professionals might be able to predict which individuals are at risk of dropout from exercise programs. Thus those at risk of dropout could be dealt with immediately in an attempt to prevent dropout.

Another limitation is the short term nature of most of the research reviewed. There is a need to examine the longer term behavioral influence of motivational regulation and affect, as well as the relationship between them.

Currently, the use of SDT to study exercise behaviors is growing but it is still quite limited (Biddle, et. al., 1999). It has been suggested that the influences of types of regulation style in contexts such as exercise requires further investigation (Wilson & Rodgers, 2004). Similarly, the research linking affect with exercise is also limited (Sexton, et. al., 2001). The factors that influence the extent to which exercise leads to improved mood are still unknown (Lane, et. al., 2002). Additionally, predictors of dropout are very rarely studied in the exercise literature.

Furthermore, affective measures have occasionally been combined with physiological measures to assess affect at different intensities of exercise (Hardy & Rejeski, 1989; Klonoff, et. al., 1994; Parfitt, Rose & Markland, 2000; Petruzzello, Hall & Ekkekakis, 2001; Lutz, et. al., 2002). Additional information is required regarding methods of measuring affect and optimal times to assess affect. Studies have measured affect in many different ways. The issue of the optimal method of affect measurement needs to be clarified.

This study will aim to further examine the relationships between motivation and affect with exercise adherence. The direct relationship between motivation and affect will also be considered. It will then be possible to examine the interactions between motivation, adherence and affect, and their relationship with exercise adherence and drop out.

Purposes

1. To determine if attendance across an exercise program could be predicted using motivation style.
2. To determine if attendance across an exercise program could be predicted using affect.
3. To assess the relationship between motivation style and affect experienced before, after and during exercise sessions.
4. To determine if affect acts as a mediator between regulation style and exercise adherence

Hypotheses

1. It was predicted that those who were more self-determined for exercise would attend more exercise sessions.
2. More positive forms of affect before, during, and after exercise will be related to higher adherence levels.
3. More self-determined forms of motivation will be related to higher levels of positive affect before, during and after exercise. Less self-determined forms of motivation will be related to higher levels of negative affect before, during and after exercise.
4. Those who demonstrate more self-determined motivation to exercise will experience more positive exercise related affective states, which will result in adherence to the exercise program. On the other hand, those who have less self-determined motives to exercise will experience more negative exercise related affect, which will result in non-adherence or dropout from the exercise program.

Affect will be examined as a mediator between regulation style and exercise attendance.

Sub-Purposes

1. The sub-purpose of purpose one was to determine if overall self-reported physical activity level could be predicted using self-determination.
2. A sub-purpose of purpose three was to determine the relationship between subjective vitality (a form of positive affect) and motivational regulation.
3. Another sub-purpose of purpose three was to determine the relationship between affect and exercise intensity during an exercise session.

Hypothesis for Sub-Purposes

1. It was predicted that those who were more self-determined for exercise would be more physically active.
2. More self-determined forms of motivation will be related to higher levels of vitality.
3. It was predicted that affect would increase as the intensity level of the exercise increased.

Exploratory Purposes

1. To identify the variables that distinguished the adherers, non-adherers and dropouts from each other.
2. To examine the patterns of motivation style over time.

In regards to the exploratory purposes, hypotheses were not proposed. The main goal of these purposes was to examine the patterns of motivation overtime, and determine the

factors that most significantly distinguished between the adherers, non-adherers, and dropouts.

Method

Design

The overall design used was repeated measures within-person. The relationships between motivation, affect, and adherence/dropout were assessed prospectively. Data was collected in different forms (questionnaires, physiological data) and at various intervals throughout the study. Data was analyzed separately at each time point address all the study purposes (See Analyses section).

Participants

Only female participants were recruited to participate in this study. Only female participants were recruited for several reasons. First, it was decided that for a legitimate between sex comparison, a larger study sample would be required than could be manageable. The literature concerning affective responses to exercise, in particular, and exercise motivation in general, tends to have more female than male participants. From the information available, however, it appears that sex might be an important independent variable in affective responses to exercise, and so it can-not be assumed that men and women could be collapsed together. Furthermore, because a convenience sampling approach was used, the exact numbers of men and women who might participate could not be accurately anticipated, except that more women than men were expected. In order to avoid a problem recruiting men (which has been observed in previous research) and thereby ending up with, essentially two unequal samples that could not be combined, it was decided to restrict the participants to women only. Beginner exercisers as well as

those who were advanced exercisers were admitted into the study. In order to achieve a power of .80, the aim was to have an N of 82. This statistical power analysis calculation was based on the relationships among the four variables involved in statistical inference: sample size (N), significance criterion (α), population effect size (ES), and statistical power (Cohen, 1992). Using Friedman's power tables (Friedman, 1982) with a $\alpha = .05$, $r_m = .30$ (equivalent to a product moment correlation coefficient), and power = .80, it is shown that the required sample size was 82 (Allison, Gorman & Primavera, 1993). A total of 88 females with a mean age of 24.36 participated in this study. A total of 66 participants completed the study, meaning they filled out all questionnaires and attended the exercise appointments and fitness tests at both time points. This was a relatively healthy sample with a mean BMI (Body Mass Index) of 24.90, and mean blood pressure of 112/66 (please see Table 1).

These young women were healthy and reported activity levels consistent with or higher than the recommended levels in Canada's Physical Activity Guide (Health Canada & Canadian Society for Exercise Physiology) based on frequency of exercise (see Table 2). Other various measures were taken to describe the sample (see Table 3). Only one of the participants reported taking vitamin supplements. There were also a very low number of participants who reported that they smoked. Most of the women in the sample were single and did not have the responsibility of child care. Overall the sample was well educated. Participants were asked to report their daily activities by selecting up to two activities from a list. A large majority of the sample were students, many of whom also had part time jobs.

Table 1

Physical Characteristics of Sample

	Time 1					Time 2				
	N	Min	Max	Mean	Std. Dev	N	Min	Max	Mean	Std. Dev
Age	86	17	57	24.36	8.61					
Height	86	53.5	72	64.18	4.00					
Weight	86	42.9	117.2	65.78	12.06	66	42.7	116.7	65.26	12.00
BMI	86	16.8	41.7	24.90	5.16	66	16.7	41.5	25.02	5.36
Systolic Blood Pressure	85	90	165	111.91	11.30	66	89	128	108.82	8.03
Diastolic Blood Pressure	85	50	88	66.07	7.55	66	48	82	67.11	8.20

Table 2

Overall Activity Level of Sample at Three Time Points

	N	Min	Max	Mean	Std. Dev.
Mets Time 1	88	3	170	44.15	29.15
Mets Time 2	66	9	270	60.61	42.69
Mets Time 3	66	0	627	65.20	75.20

Table 3

Demographic Characteristics of Sample

Taking Supplements		Frequency	Percent
	Yes	1	1.14
	No	84	95.45
	Total	85	96.59
Smoker		**Frequency**	**Percent**
	Yes	1	1.14
	No	80	90.91
	Sometimes	4	4.55
	Total	85	96.59
Marital Status		**Frequency**	**Percent**
	Single	74	84.09
	Married	3	3.41
	Separated	1	1.14
	Divorced	4	4.55
	Widowed	1	1.14
	Common Law	5	5.68
	Total	88	100
Responsible for Child Care		**Frequency**	**Percent**
	Yes	2	2.27
	No	85	96.59

	Total	87	98.86
	Missing	1	1.14
	Total	88	100
Education		Frequency	Percent
	Less than grade 12	2	2.27
	High school diploma	57	64.77
	Bachelor's degree	22	25
	Master's degree	5	5.68
	Professional	1	1.14
	Other	1	1.14
	Total	88	100
Daily Activities		Frequency	Percent
	Full time student	71	80.68
	Part time student	3	3.41
	Working full time	9	10.23
	Working part time	3	3.41
	Other	2	2.27
	Total	88	100
Daily Activities Question 2		Frequency	Percent
	Full time student	1	1.14
	Working part time	31	35.23
	Looking for work	4	4.55

Keeping house/raising children	3	3.41
Other	3	3.41
Total	42	47.73
Missing	46	52.27
Total	88	100

Measures

Five instruments were used in this study. All instruments are provided in Appendices A to G.

Motivational Style

Motivation style was assessed using the Behavioral Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997). The BREQ assesses *external regulation* (e.g. "I exercise because my friends and family say I should"), *introjected regulation* (e.g. "I feel guilty when I don't exercise"), *identified regulation* (e.g. "I value the benefits of exercise"), and *intrinsic regulation* (e.g. "I exercise because it is fun"). This questionnaire consists of 19 items. Each item is responded to on a five-point Likert scale ranging from 1 (not true for me) to 5 (very true for me) see Appendix A. Cronbach's alpha is a measure of internal consistency; it reflects the mean inter-item correlation of all the items compromising a subscale in a measure (Bostic, Rubio & Hood, 2000). Reliability refers to the instrument's ability to yield the same results repeated over a number of trials. In other words the instrument is reliable if consistent results are found in repeated measurements. Based on the work of Wilson, Rodgers and

Fraser (2002) the BREQ has been demonstrated to exhibit acceptable validity in similar samples of exercisers and to have good internal consistency ($\alpha > .75$). In the present study the internal consistency of the BREQ ranged from .67 to .93.

Affect

Affect before and after exercise was assessed using the Positive Affect Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS consists of two 10-item scales: positive affect (PA) and negative affect (NA). Words such as, *excited, inspired, strong, nervous, guilty*, and *irritable* are scored on a five-point Likert scale ranging from 1 (not at all) to 5 (extremely) See Appendix B. According to Crocker (1997) the PA and NA scales have been demonstrated to have adequate internal consistency ($\alpha > .84$) in samples of exercisers. The PANAS is valid for adult populations shown through the COD (coefficient of determination) of .99 indicating the PANAS items jointly act to measure the variables (Crocker, 1997). In this study the internal consistency of the PANAS ranged from .52 - .96 suggesting low to high internal consistency.

The Feeling Scale (FS; Rejeski et. al., 1995) was used to measure affect during exercise bouts. The FS is a one-item measure assessing whether a person feels good/bad. It is scored on an 11-point bipolar scale ranging from +5 (very good) to -5 (very bad) See Appendix C. The FS has been demonstrated to have good face and content validity (Hardy & Rejeski, 1989). See Appendix B and C.

Vitality

The Subjective Vitality Scale (Ryan and Frederick, 1997) was used to assess the subjective feeling of being alive and awake, a positive affective state. It consists of seven

items all measuring subjective vitality (e.g. I look forward to each new day). The items are scored on a 7-point Likert scale. This instrument has been demonstrated to have good internal consistency ($\alpha > .84$) (Bostic et. al., 2000). In this study the internal consistency for the Subjective Vitality Scale ranged from .73 to .79 across time. One of the items requires reverse scoring when doing the analysis (See Appendix E).

Self-Reported Physical Activity

The Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985) was used to assess current physical activity levels of participants. The GLTEQ is a seven day physical activity recall survey. It provides information about the frequency of strenuous, moderate, and light activities. A total leisure time physical activity score can be obtained using a simple formula: (strenuous * 9 METS) + (moderate * 5 METS) + (light * 3 METS) See Appendix D. This measure has been demonstrated to have good test-retest reliability ($r = .82$) and established content validity (Chung & Phillips, 2002).

Physical Fitness or VO_2

The Astrand Rhyming bike test is one of the most widely used sub-maximal exercise tests (Astrand & Rodahl, 1977). This is a 6-minute test on a stationary bike used to assess sub-maximal VO_2. A nomogram is used to estimate VO_2 max from sub-maximal heart rate and the associated workload (kgm x min^{-1}) on a bicycle ergometer. Before the test there is a 2-minute warm up at no resistance at 50 rpm, after the 6-minute test there is also a cool down. At each minute of the test the heart rate is taken. The goal is for the exerciser to reach steady state by minute 6. The heart rate should be between 130 and 150 per minute. This steady state heart rate is put into a series of equations so VO_2 max can be estimated from the participants heart rate. The test-retest reliability of

this procedure .94 (Astrand & Rodahl, 1977). A heart rate monitor was used to measure heart rate during the three cardio exercise sessions. The use of the heart rate monitors allowed affect to be assessed at the specific intensities outlined above.

Attendance

Participants recorded their attendance in two ways: on attendance sheets and exercise logs (see Appendix F and G). Attendance was defined as number of exercise sessions attended. The attendance sheets were used for a daily check mark system. The exercise logs were much more detailed, including information on each work out the participant completed (type of exercise, number of repetitions, amount of weight, additional exercises such as stretching or taking exercise classes). The adherers and dropouts were differentiated based on the number of exercise sessions they attended.

In order to define dropout, adherence frequency and consistency were both considered. At the completion of the study the participants were divided into groups based on their level of participation. Adherers were defined as those who attended over 50% of the exercise sessions. The dropouts were those who informed the researcher that they were dropping out and those who attended less than one third of the exercise sessions (Schachter, Busch, Peloso & Sheppard, 2003). Those who consistently attended the exercise sessions and then stopped were also considered to be dropouts. Non-adherers were those who attended more than 33% and less than 50% of the sessions and completed all other aspects of the study.

Procedures

Female participants were recruited to participate in the study via ads and posters on the University of Alberta campus. The ads targeted healthy females and invited them

to come to an information session about participating in an exercise study involving an exercise program. The study was explained at the information session. Time commitment, required responsibilities of the participant, and benefits and risks of participating were discussed. For those who agreed to participate, consent forms were signed and collected. Then, questionnaires assessing demographic variables, motivation style (BREQ), exercise related affect (PANAS), subjective vitality (SVS) and current exercise behavior (GLTEQ) were completed and handed in. These questionnaires comprised the baseline measures. During this info session participants also scheduled their baseline fitness tests. At the fitness test a variety of measures were taken: height, weight, blood pressure, and sub maximal VO_2 using the Astrand Rhyming 6-minute bike test. Body mass index (BMI) was calculated from the height and weight data.

Participants were also asked to attend at least one instructional session to learn how to use the exercise equipment in the gym and how to work at the appropriate intensity for their fitness level. At this time, participants were shown how to fill out their workout logs and sign the attendance sheets at the gym. Throughout the study, attendance was monitored using the exercise logs and attendance sheets. The participants reported specific exercises, repetitions and sets on their exercise logs. The attendance sheets were used for participants to put checkmarks on the days they exercised. Participants who had poor attendance were contacted to determine if they were study dropouts or exercise dropouts. At the completion of the study attendance scores were calculated. The adherers, non-adherers and dropouts were divided into groups and analyses were conducted according to the study purposes.

Participants were contacted prior to weeks 4, 7, and 10 to schedule supervised cardiovascular exercise sessions to assess exercise-related affect. During these sessions the participants were asked to ride a stationary bike for 20 minutes and wore heart rate monitors so affect could be assessed at different heart rate intensities. The researcher was responsible for monitoring the participant's heart rate, asking about their affective state using the Feeling Scale (FS), and recording the responses. The FS was administered immediately before and after exercise, as well as at various intensities (at 50, 60, 70, 80 and 85% of maximal heart rate calculated by 220-age). These intensities were chosen based on those reported in the literature. The participants also completed the PANAS before and after these sessions.

At the study mid-point (week 6), and at the completion of the study, motivational style was assessed again using the BREQ.

Analyses

Analyses Relating to the Purposes

1. To address the purpose of determining if attendance could be predicted at three time points using motivation style, regressions were conducted.
2. To address the purpose of determining if attendance could be predicted at three time points using affect, regressions were conducted.
3. To address the purpose of assessing the relationship between motivation style and affect, a correlational analysis was done between the BREQ and the PANAS, and the BREQ and the FS at all three time points.
4. To address the purpose of determining if affect mediated the relationship between regulation style and adherence, a mediation analysis was conducted.

Analyses Relating to the Sub-Purposes

1. To address the sub-purpose of purpose one to determine if physical activity could be predicted using self-determination regressions were conducted.
2. To address the sub-purpose of determining the relationship between subjective vitality (a form of positive affect) and motivational style, a correlational analysis was conducted at all three time points.
3. To address the sub-purpose of assessing the relationship between affect and exercise intensity, affect during exercise was correlated with exercise intensity (heart rate).

Analyses Related to the Exploratory Purposes

1. To address the exploratory purpose of distinguishing adherers, non-adherers and dropouts from each other three attendance based groups were created. The groups were compared using ANOVA procedures.
2. To address the exploratory purpose of determining the patterns of motivation change over time a repeated-measures MANOVA was conducted.

Results

Assumptions

The data were examined for violations of the assumptions of linearity, normality and homoscedasticity relevant to the regression analyses. Statistical inference can be less powerful as distributions become less normal. Therefore, it was important to address these assumptions to determine the validity of the inferences that could be made from the analyses. When the normality assumption for raw scores is satisfied the values of skewness and kurtosis are close to zero and the mean falls somewhere towards the middle

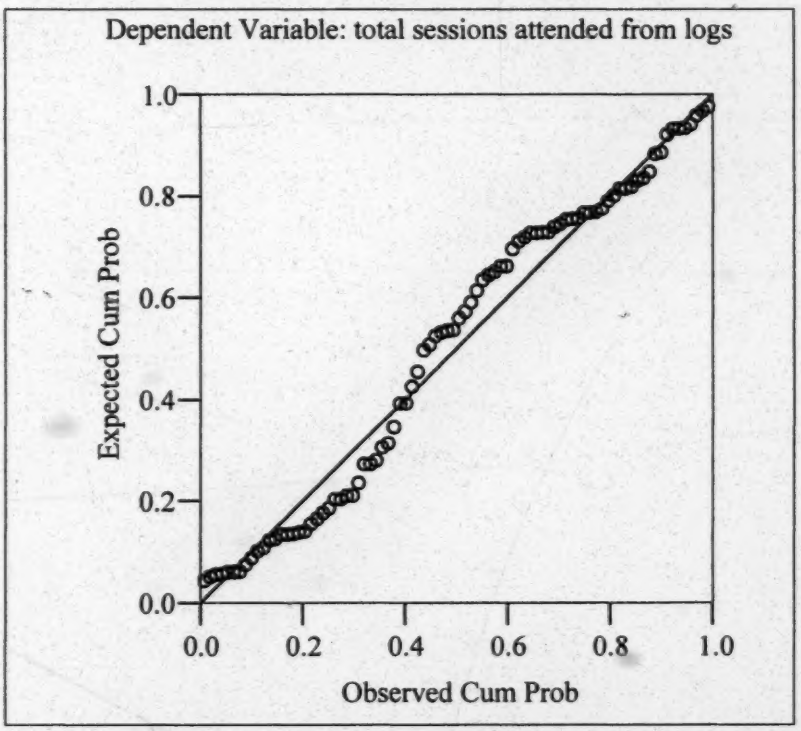
of the distribution. For bivariate relationships, as in regression, the normality assumption can be addressed by examining plots of the residual scores. The residual scores are the differences between the observed scores and the values predicted by the model (Norusis, 1990). If the model is appropriate, the residuals will show similar characteristics to the predicted values. The assumption of linearity is satisfied when a straight-line relationship occurs between two variables. This assumption is important to assess as Pearson's *r* only captures the linear relationships among variables. The assumption of homoscedasticity is that the variability in scores for one continuous variable is roughly the same at all values of another variable. Homoscedasticity is related to the assumption of normality because when the assumption of multivariate normality is met, the relationships between the variables are assumed to be homoscedastic (Tabachnik & Fiddell, 2001). In addition, each variable was examined for extreme values. It was found that there were few outliers in this sample (see Appendix J).

To look for violations of the assumptions of linearity, normality and homoscedasticity, several residual plots were examined. Normality of the dependent variable was considered using the "normal probability (P-P) plot" generated by SPSS, which plots the observed values of each variable against the expected values. If a relatively straight line is observed, a relatively linear relationship between the observed and expected values is revealed and the variables are assumed to be normally distributed. Furthermore, this plot allows for some identification of outliers by examining observed values that fall below the line (indicating fewer than expected observations) or above the line (indicating more than expected observations). A sample P-P plot is provided in Figure 1 portraying the observed and expected values for "attendance", the main

dependent variable. Outliers were also identified from the list of outliers (those values more than three standard deviations from the mean) also provided by SPSS.

Figure 1

Normal P-P Plot of Regression Standardized Residual

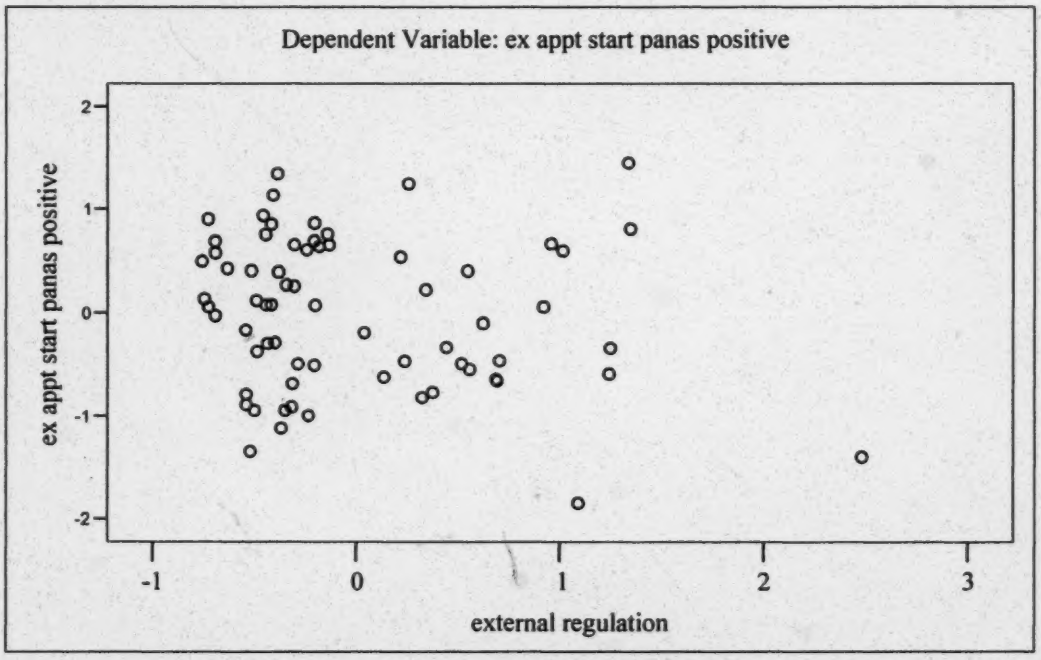


Additionally, to examine the relationships between the dependent (attendance) and independent (forms of motivation or affect) variables, scatterplots of the residuals of each pair of variables were examined in a partial regression plot. Form these plots it was possible to determine if there was any pattern in the independent variables' residuals associated with each value of the dependent variable. A lack of pattern (a random scatter plot) indicates that the variance was not associated with any particular value of the dependent variable and the assumption that the variance was similar across all values (homoscedastic) is upheld. This plot also reveals that the assumption of linearity is met if

there is no observable pattern in the association between the independent variable and the residual values of the dependent variable (Norusis, 1990). An example of such a plot is presented in Figure 2 where external regulation is the independent variable plotted against positive affect represented by PANAS at Time 1 as the dependent variable.

Figure 2

Partial Regression Plot



There were nine variables that were assessed according to the above three assumptions: attendance, extrinsic regulation, introjected regulation, identified regulation, intrinsic regulation, pre-exercise positive affect, pre-exercise negative affect, post-exercise positive affect and post-exercise negative affect. These latter eight variables were assessed at three time points. To test the normality assumption the normal P-P plot of regression was visually inspected for each variable. When the normality assumption was tested on attendance, only slight deviation was observed. Positive pre-exercise affect

and positive post-exercise affect scores were found to satisfy the normality assumption with only minor deviations at the three time points. Negative pre-exercise affect and negative post-exercise affect were found to minimally satisfy the normality assumptions as the deviations were found to be relatively large. The four BREQ sub-scales were also assessed against the normality assumption and it was found to be satisfied.

The linearity assumption was assessed by visually examining the partial regression plot for each of the BREQ sub-scales against attendance. When the partial regression plots for each of the BREQ sub-scales with attendance were examined it was found that the linearity assumption appeared to be met. For the most part, the partial regression plots for each of the independent variables (i.e., the four BREQ subscales and the PANAS subscales) with the dependent variable (attendance) showed no particular pattern of association. The partial regression plots examining the BREQ sub-scales with the PANAS subscales as the dependent variables also showed no particular pattern of association. This indicates that there were no severe violations of the linearity or homogeneity assumptions.

Overall, there was little indication that the assumptions of normality, linearity or homoscedasticity were violated. Additionally, there were few outlying scores on any of the variables of interest. As a result, some confidence can be applied to the interpretations of the correlation-based analyses reported here.

Self-Determination as a Predictor of Attendance

To determine if attendance could be predicted using self-determination, attendance was regressed on the BREQ sub-scales. It was hypothesized that those who were more self-determined for exercise would attend more exercise sessions. Separate

regression analyses were conducted at each of the three time points. The standardized Beta coefficients were reported instead of the unstandardized Beta coefficients. The standardized Beta is a dimensionless coefficient as it takes into account the variance from the dependent variables not shared with other variables. In other words, the standardized Beta does not allow variance between variables to overlap, therefore no shared variance is reported. The standardized Beta values were compared to the relevant zero-order correlations, to determine whether there were unexpected relationships. The correlation matrices are presented Appendix H. A significant regression equation was observed only at Time 2. The only significant predictor of attendance at Time 2 was introjected regulation which had a negative standardized Beta weight, this finding was consistent with the zero-order correlations. This result suggests that those with higher levels of introjected regulation at Time 2 also had lower levels of attendance. However, the overall R^2 only accounted for 13% of the variance in behavior. The results of these three analyses are presented in Tables 4 to 6. These results do not support the hypothesis.

Table 4

Regression of BREQ at Time 1 Predicting Number of Sessions Attended

Variable in Model	Standardized B	t	p
External	-0.05	-0.46	ns
Introjected	-0.20	-1.75	0.08
Identified	0.11	0.78	ns
Intrinsic	0.11	0.82	ns

$R^2adj = .025, F(4,81) = 1.550, p < .196$

Table 5

Regression of BREQ at Time 2 Predicting Number of Sessions Attended

Variable in Model	Standardized B	t	p
External	0.24	1.78	0.08
Introjected	-0.37	-2.74	0.01
Identified	0.08	0.46	ns
Intrinsic	0.22	1.29	ns

$R^2adj = .134, F(4,61) = 3.507, p < .012$

Table 6

Regression of BREQ at Time 3 Predicting Number of Sessions Attended

Variable in Model	Standardized B	t	p
External	0.18	1.15	ns
Introjected	-0.32	-2.16	0.04
Identified	-0.12	-0.65	ns
Intrinsic	0.26	1.46	ns

$R^2adj = .048, F(4,81) = 1.798, p < .141$

The pattern of relationships between the independent and dependent variables revealed by each of the regression analyses was compared to the pattern of relationships observed in the relevant zero-order correlations reported in Appendix H. The standardized Beta's were found to be consistent with correlations.

Affect as a Predictor of Attendance

The second purpose was to determine if attendance could be predicted at the three time points using affect, assessed before and after exercise sessions. Again, the

standardized Beta's were reported instead of the unstandardized Beta's. Regressions were conducted to address the hypothesis that more positive forms of affect before and after exercise would positively predict attendance levels. The pattern of prediction revealed by the regressions was compared to the pattern of relationships observed in the zero-order correlations reported in Appendix I. The standardized Beta's were found to be consistent with correlations. The results are reported in Tables 7 through 9. These analyses revealed no significant effects. Therefore, this hypothesis was not supported.

Table 7

Regression of PANAS Before and After Exercise at Time 1 Predicting Number of Sessions Attended

Variable in Model	Standardized B	t	p
Start Panas Positive	-0.10	-0.58	ns
Start Panas Negative	-0.37	-2.16	0.03
End Panas Positive	0.06	0.33	ns
End Panas Negative	0.09	0.53	ns

$R^2adj = .038$, $F(4,65) = 1.688$, $p < .163$

Table 8

Regression of PANAS Before and After Exercise at Time 2 Predicting Number of Sessions Attended

Variable in Model	Standardized B	t	p
Start Panas Positive	-0.12	-0.63	ns
Start Panas Negative	0.05	0.22	ns
End Panas Positive	0.23	1.24	ns
End Panas Negative	-0.21	-0.88	ns

$R^2adj = -.005, F(4,58) = .917, p < .460$

Table 9

Regression of PANAS Before and After Exercise at Time 3 Predicting Number of Sessions Attended

Variable in Model	Standardized B	t	p
Start Panas Positive	-0.04	-0.20	ns
Start Panas Negative	0.07	0.36	ns
End Panas Positive	0.27	1.48	ns
End Panas Negative	-0.23	-1.25	ns

$R^2adj = .038, F(4,61) = 1.648, p < .174$

Correlation Between Motivation Style and Affect Before and After Exercise (PANAS)

The third purpose was to assess the relationship between motivation style and affect. More specifically, to examine the relationship between the BREQ and affect before and after exercise (the PANAS), and the BREQ and affect experienced during exercise (the FS) at all three time points. The relationship between the BREQ and the

PANAS will be addressed first. A correlational analysis was conducted at all three time points. It was hypothesized that those who demonstrated more self-determined motivation to exercise would experience more positive affective states before and after exercise. The pre and post-exercise scores on the PANAS are presented in Table 10. The correlations between the PANAS scores and the motivation regulations (BREQ subscales) are presented in Table 11 for Time 1; Table 12 for Time 2; and Table 13 for Time 3. Variation in the number of participants at each time point reflects the total number of participants providing data. Not all participants completed all aspects of the study.

Table 10

Before and After Exercise PANAS Scores Across Three Sessions

	Time 1			Time 2			Time 3		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Before Exercise Panas Positive	70	2.93	0.78	63	2.80	0.68	66	3.05	0.87
Before Exercise Panas Negative	70	1.38	0.41	63	1.24	0.31	66	1.24	0.30
After Exercise Panas Positive	70	3.55	0.73	63	3.39	0.78	66	3.53	0.85
After Exercise Panas Negative	70	1.15	0.24	63	1.09	0.14	66	1.11	0.21

At time one, significant positive relationships were found between pre-exercise negative affect and external and introjected regulation, r =.39 and r =.37 respectively. Post-exercise, significant positive relationships were found between positive affect and identified and intrinsic regulation (r = .25 and r = .34 respectively), and between negative affect and external regulation and introjected regulation (r = .27 and r = .34 respectively).

These relationships show a positive association between negative affect and less self-determined forms of motivation before and after exercise. They also show a positive association between positive affect and more self-determined motivation after exercise. This exercise session was early in the 11-week exercise program.

Table 11

Correlations between Pre and Post Exercise PANAS Scores and Regulation Styles at Time 1 (n=70)

		Regulation Style			
		External	Introjected	Identified	Intrinsic
Pre-exercise	Positive Affect	-0.19	-0.05	0.20	0.21
	Negative Affect	0.39**	0.37**	-0.04	-0.22
Post-exercise	Positive Affect	-0.03	-0.14	0.25*	0.29*
	Negative Affect	0.27*	0.34**	0.00	-0.13

* $p<.05$, ** $p<.01$

At Time 2, in the middle of the exercise program similar relationships were observed. Negative affect is associated with less self-determined forms of motivation and positive affect is associated with more self-determined forms of motivation.

Table 12

Correlation between Pre and Post Exercise PANAS Scores and Regulation Styles at Time 2 (n=63)

		Regulation Style			
		External	Introjected	Identified	Intrinsic
Pre-exercise	Positive Affect	-0.19	-0.18	0.15	0.31*
	Negative Affect	0.41**	0.41**	-0.06	-0.13
Post-exercise	Positive Affect	-0.17	-0.09	0.32*	0.45**
	Negative Affect	0.40**	0.37**	-0.11	-0.13

* $p<.05$, ** $p<.01$

At time three, in the latter part of the 11-week program similar patterns of association were observed again. Negative affect remained associated with less self-determined motivation and positive affect was again associated with more self-determined motivation.

Table 13

Correlation between Pre and Post Exercise PANAS Scores and Regulation Styles at Time 3 (n=66)

		Regulation Style			
		External	Introjected	Identified	Intrinsic
Pre-exercise	Positive Affect	-0.07	0.00	0.31*	0.50**
	Negative Affect	0.36**	0.24*	-0.05	-0.14
Post-exercise	Positive Affect	-0.07	0.10	0.45**	0.57**
	Negative Affect	0.38**	0.22	0.01	-0.13

* p<.05, **p<.01

These results show that those who had more self-determined motivation for exercise experienced more positive affective states both pre and post exercise and these relationships were maintained over time. Those who were less self-determined to exercise experienced more negative affective states both pre and post exercise, and this relationship was less stable over time, as evidenced by larger fluctuations in the observed correlations. These results partially support the hypothesis.

Correlation Between Motivation Style and Affect During Exercise (FS)

To determine the relationship between motivational style and affect during exercise a correlational analysis was conducted between scores on the FS and the BREQ at all three time points. It was hypothesized that those who had more self-determined forms of motivation would experience more positive affect during exercise. The scores on the FS at each intensity based assessment point are reported in Table 14. The correlations between the FS and the forms of motivational regulation at each exercise

intensity are presented in Table 15 for the first exercise session, Table 16 for the middle exercise session and Table 17 for the last exercise session.

Table 14

Feeling Scale Scores Before, After, and During Exercise Across Three Time Points

	Time 1			Time 2			Time 3		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Before exercise	70	2.28	1.70	63	2.05	1.61	66	2.23	1.56
50% max heart rate	45	2.08	1.73	33	2.03	1.63	63	2.22	1.44
60% max heart rate	68	2.42	1.49	61	2.17	1.54	66	2.33	1.41
70% max heart rate	68	2.49	1.29	62	2.27	1.40	66	2.26	1.40
80% max heart rate	52	2.44	1.35	49	2.30	1.35	51	2.22	1.40
85% max heart rate	35	2.16	1.34	27	2.41	1.15	34	2.03	1.60
After exercise	70	3.12	1.23	63	3.17	1.26	66	2.99	1.42

Table 15

Correlation between Feeling Scale Scores During Exercise and Regulation Styles at Time 1 (n=70)

	Regulation Style			
	External	Introjected	Identified	Intrinsic
Start	-0.11	-0.11	0.08	0.10
50% of max	-0.18	0.07	0.11	0.13
60% of max	-0.05	-0.08	0.19	0.17
70% of max	-0.10	-0.12	0.26*	0.28*
80% of max	-0.10	-0.27	0.18	0.49**
85% of max	-0.02	-0.39*	0.33	0.44**
End	-0.09	0.20	0.52**	0.58**

* $p<.05$, ** $p<.01$

The significant correlations show a positive association between more self-determined motivation and positive affect experienced during exercise in session 1. There is one negative association between affect experienced during exercise and introjected motivation at the high intensity of 85% of maximum heart rate. This shows more negative affect at this intensity with high levels of introjected motivation.

Table 16

Correlation between Feeling Scale Scores During Exercise and Regulation Styles at Time 2 (n=63)

	Regulation Style			
	External	Introjected	Identified	Intrinsic
Start	-0.17	-0.27*	0.11	0.23
50% of max	-0.14	-0.35	0.16	0.26
60% of max	-0.24	-0.31*	0.16	0.27*
70% of max	-0.17	-0.22	0.20	0.33**
80% of max	-0.25	-0.19	0.25	0.36**
85% of max	-0.26	-0.05	0.14	0.20
End	-0.06	-0.14	0.23	0.31*

* $p<.05$, ** $p<.01$

At exercise session 2, in the middle of the 11-week program, again we see positive associations between affect experienced during exercise and more self-determined forms of regulation. We also see an increased number of negative associations between affect experienced during exercise and less self-determined forms of regulation at lower exercise intensities. The pattern of associations is consistent with the hypothesis.

Table 17

Correlation between Feeling Scale Scores During Exercise and Regulation Styles at Time 3 (n=66)

	Regulation Style			
	External	Introjected	Identified	Intrinsic
Start	-0.04	-0.09	0.12	0.22
50% of max	0.00	-0.05	0.12	0.21
60% of max	-0.03	-0.12	0.12	0.29*
70% of max	-0.03	-0.14	0.21	0.34**
80% of max	-0.03	-0.12	0.39**	0.56**
85% of max	0.13	-0.07	0.36*	0.55**
End	-0.09	0.02	0.31*	0.40**

* $p<.05$, ** $p<.01$

At the third exercise session a similar pattern of associations between positive affect and more self-determined motivation is observed. No associations between affect and less self-determined motives are observed this time.

Overall, the results show that positive scores on the FS at higher heart rate intensities were more highly correlated with more self-determined forms of motivation (see Tables 15 to 17). This shows an association between more self-determined motivation, exercise intensity and positive affect, that is consistent with the hypothesis.

Affect as a Mediator of the Relationship between Regulation Style and Exercise Session Attendance

To determine whether affect mediated the relationship between regulation style and exercise adherence, four separate analyses were performed according to the recommendations of Baron and Kenny (1986). Baron and Kenny (1986) recommend that the first step should be to regress the mediator on the independent variable; second, to regress the dependent variable on the independent variable, and third, to regress the dependent variable on both the independent variable and on the mediator. Because attendance reflects the entire 11 weeks of exercise, this analysis used only the regulation styles and affect observed at Time 1. A multivariate approach to testing the hypotheses proposed was undertaken. That is, no specific hypotheses were developed for the specific forms of motivation represented by the BREQ, so all four forms were entered in a block. In the mediation analysis, the first step was to determine the relationship between the independent variable (BREQ) and the mediator (affect). Baron & Kenny recommend using correlation for this step. Three regressions were then conducted. First, the mediator (affect) was regressed on the independent variable (BREQ). Because positive and negative affect was assessed before and after exercise, this step required four analyses using each measure of affect as the criterion variable. Second the dependent variable (attendance) was regressed on the independent variable (BREQ). Third, the dependent variable (attendance) was regressed on both the independent variable (BREQ) and the mediator (affect).

Table 18

Regression of Positive Pre-Exercise Affect on the Motivation Style

Variable in Model	Standardized B	t	p
External	-0.18	-1.51	0.14
Introjected	-0.08	-0.64	0.53
Identified	0.20	1.27	0.21
Intrinsic	0.10	0.67	0.50

$R^2adj = .067, F(4,63) = 2.20, p < .079$

Table 19

Regression of Negative Pre-Exercise Affect on Motivation Style

Variable in Model	Standardized B	t	p
External	0.31	2.83	.006
Introjected	0.33	2.86	.006
Identified	-0.02	-0.15	.880
Intrinsic	-.017	-1.24	.218

$R^2adj = .240, F(4,63) = 6.29, p < .001$

Table 20

Regression of Positive Post-Exercise Affect on Motivation Style

Variable in Model	Standardized B	t	p
External	0.02	0.20	0.84
Introjected	-0.22	-1.75	0.09
Identified	0.24	1.52	0.13
Intrinsic	0.21	1.41	0.17

$R^2adj = .119$, $F(4,63) = 3.26$, $p < .017$

Table 21

Regression of Negative Post-Exercise Affect on Motivation Style

Variable in Model	Standardized B	t	p
External	0.20	1.69	0.10
Introjected	0.31	2.53	0.01
Identified	-0.03	-0.16	0.87
Intrinsic	-0.09	-0.60	0.55

$R^2adj = .119$, $F(4,63) = 3.26$, $p < .017$

The correlations between affect and the BREQ sub-scales are reported in Tables 11 to 13 (correlation matrices for Regulation Style and Attendance, and Pre and Post Exercise Affect and Attendance are reported in Appendix H and I respectively). In the first stage of the mediation analysis, three of the four regression analyses yielded significant equations. The results of these analyses are reported in Tables 18 through 21. Table 18 shows no significant association between pre-exercise positive affect and motivation style. However, it can be seen that negative affect before and after exercise was

positively associated with less self-determined motivation (see Tables 19 and 21). These relationships are consistent with SDT and show that there are relationships between some forms of motivational style and some forms of affect that might differentially influence attendance. In the second stage of analysis required to establish mediation it was found that the BREQ did not significantly predict attendance. These analyses are presented in Tables 4 to 6. A relationship between the dependent variable (attendance) and the independent variable (BREQ) did not exist, therefore, the conditions required to establish mediation were not satisfied. Consequently, mediation could not be determined and the third regression analysis recommended by Baron and Kenny was not conducted.

In summary, the mediation analysis was attempted but could not be completed because the required relationships did not exist. It was found that regulation style was not associated with attendance.

Sub-Purposes

Motivation Style as a Predictor of Physical Activity

To address the first sub-purpose of determining if regulation styles could predict activity level, a regression was done between the BREQ sub-scales and METS (calculated from the GLTEQ) at all three time points. It was hypothesized that those with more self-determined forms of motivation would have higher activity levels. At Time 1 intrinsic motivation emerged as a significant predictor of METS, accounting for 24% of the variance (see Table 22) (this relationship was also supported by the zero-order correlation $r = .517$). Therefore, this hypothesis was only supported at Time 1. Note that at Time 1 the METS scores represented the general activity level of the participant.

However, at Times 2 and 3, METS scores represented the activity level only over the four weeks immediately prior to the assessment point.

Table 22

Regression of Motivation Style Predicting METS at Time 1

Variable in Model	Standardized B	t	p
External	-0.26	-0.27	ns
Introjected	-0.01	-0.05	ns
Identified	0.13	1.02	ns
Intrinsic	0.44	3.68	0.00

$R^2adj = .24, F(4,81) = 7.81, p < .0001$

At Time 2 there were no significant predictors of METS scores (see Table 23).

Table 23

Regression of Motivational Style Predicting METS at Time 2

Variable in Model	Standardized B	t	p
External	-0.19	-1.36	ns
Introjected	-0.04	-0.30	ns
Identified	-0.05	-0.28	ns
Intrinsic	0.17	0.94	ns

$R^2adj = .025, F(4,61) = 1.415, p < .240$

At Time 3, external regulation emerged as a significant predictor of METS. This was a negative relationship accounting for 12% of the variance (see Table 24) (this relationship was also supported by the zero-order correlation $r = -0.18$). This suggests that those with the lowest scores on external regulation had the highest self-reported activity levels.

Table 24

Regression of Motivational Style Predicting METS at Time 3

Variable in Model	Standardized B	t	p
External	-0.28	-1.91	0.06
Introjected	0.02	0.12	ns
Identified	0.28	1.56	ns
Intrinsic	0.10	0.60	ns

$R^2adj = .118, F(4,60) = 3.150, p < .020$

Over time we see inconsistent relationships between the specific motivational styles and self-reported activity levels.

Correlation between Motivation Style and Subjective Vitality

The second sub-purpose was to determine the relationship between subjective vitality (a form of positive affect) and the BREQ at all three time points. The vitality measures were taken at week 4, 7, and 11, the means and standard deviations for vitality at all three time points are reported in Table 25. It was hypothesized that more self-determined forms of motivation would be related to higher levels of vitality. Correlation analyses showed that higher vitality scores were positively associated with more self-determined forms of motivation at all three time points (see Table 26). This relationship remained stable over time showing that motivation and vitality are related therefore, the hypothesis was supported.

Table 25

Vitality Scale Scores Across Three Time Points

	Time 1			Time 2			Time 3		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Vitality	88	4.74	1.17	66	4.68	1.09	66	4.78	1.04

Table 26

Correlation between Vitality Scale Scores and Regulation Styles at Time 1, 2, and 3 (n=66)

	Regulation Style			
	External	Introjected	Identified	Intrinsic
Vitality Time 1	-0.09	0.20	0.52**	0.58**
Vitality Time 2	-0.31*	-0.15	0.51**	0.73**
Vitality Time 3	-0.21	-0.06	0.41**	0.67**

* p<.05, **p<.01

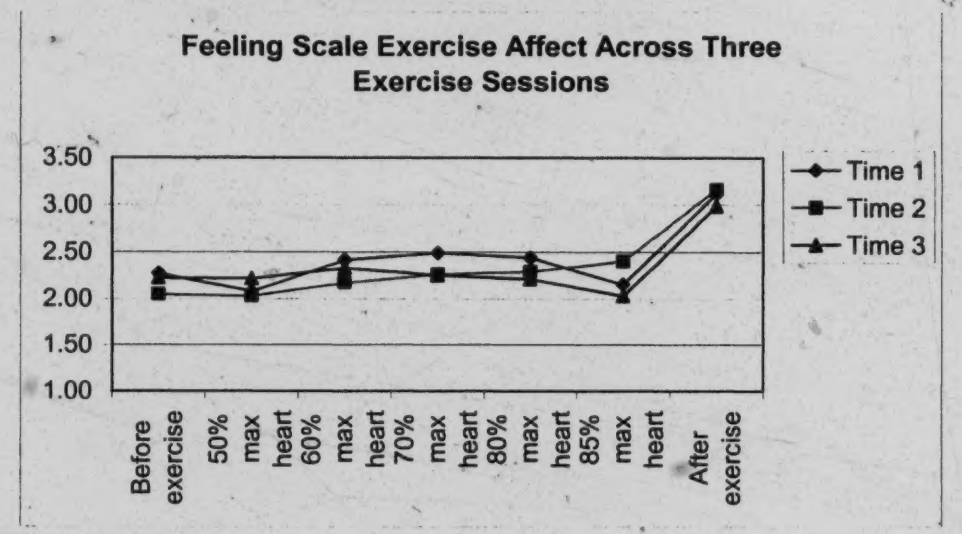
Relationship Between Intensity and Affect During Exercise

The final sub-purpose was to assess the relationship between exercise intensity and affect. Generally, exercise affect during the session increased as heart rate increased from 50% to 70% of max heart rate, after this point exercise affect began to decrease, especially at 85% of max heart rate where affect tended to be lower. These affect scores during the workout tended to follow a similar pattern at all three exercise appointments (see Figure 1). The hypothesis that affect would increase as intensity increased was partially supported. It appears that affect during exercise during exercise declines at very

high (i.e. difficult) intensities. This decline seems to begin after about 70% of max heart rate (HR max).

Figure 3

Feeling Scale Exercise Affect Across Three Exercise Sessions



Exploratory Analysis

Comparison of Dropouts, Non-adherers and Adherers

One of the exploratory purposes was to identify the variables that distinguished between the adherers, non-adherers and dropouts from each other. In order to address this purpose three attendance based groups were created: (1) dropouts attended 0-5 sessions, (2) non-adherers attended 6-15 sessions and (3) adherers attended 16-30 sessions. There were 22 dropouts, 29 non-adherers, and 37 adherers. The physical characteristics of each of the resulting groups are presented in Table 28. This table shows that the groups were similar except for their activity levels, which were self-reported using the GLTEQ and expressed as METS. Attendance was monitored using attendance sheets as well as exercise logs. The attendance sheets were scored in checklist form and

the exercise logs were more detailed as they included information on the workout the participant completed for each day. Since the exercise logs had more complete data, they were used for subsequent analysis. The attendance data for both methods are presented in Table 27.

Table 27

Attendance Data from Attendance Sheets and Exercise Logs

	Attendance Sheets					Exercise Logs				
	N	Min	Max	Mean	Std. Dev	N	Min	Max	Mean	Std. Dev
Week 1	52	1	5	2.40	1.19	78	1	3	1.78	0.91
Week 2	45	1	5	2.36	1.15	74	0	3	2.23	0.82
Week 3	50	0	5	2.32	1.17	55	1	3	2.29	0.81
Week 4	42	1	5	2.10	1.05	55	0	3	2.07	0.86
Week 5	43	1	5	2.30	1.10	55	1	3	2.20	0.83
Week 6	31	0	4	2.03	1.02	54	1	3	2.13	0.83
Week 7	41	1	5	2.56	1.12	47	1	3	2.19	0.80
Week 8	38	1	6	2.63	1.24	47	1	3	2.32	0.84
Week 9	32	1	6	1.97	1.36	44	1	3	2.00	0.89
Week 10	21	1	5	1.86	0.96	26	1	3	1.50	0.76
Sessions attended	88	0	44	10.27	9.21	88	0	28	12.72	8.20

A perfect score for attendance was 30 sessions. The maximum attendance score on the attendance sheets is inflated because some of the participants put check marks in the wrong columns and some checked off days that they did not work out. The logs were

much more accurate because participants used them to monitor their own work outs. Analyses of variance were conducted to determine which factors that distinguished between the attendance-based groups. Regulation style was hypothesized to significantly distinguish between the adherers, non-adherers, and dropouts.

Table 28

Between Groups Descriptives

	Drop-outs Mean (SD)	Non-adherers Mean (SD)	Adherers Mean (SD)
Age	25.25 (9.57)	22.9 (6.01)	24.97 (9.92)
Height	65.06 (3.36)	64.24 (4.23)	63.7 (4.19)
Weight	69.05 (14.18)	62.69 (8.60)	66.98 (12.63)
Systolic BP	111.55 (16.02)	112.76 (9.80)	111.42 (9.44)
Diastolic BP	66.7 (7.71)	66.97 (7.82)	65 (7.32)
BMI	25.48 (5.86)	23.78 (4.50)	25.66 (5.19)
METS	$34.75\ (21.31)_a$	$39.24\ (22.86)_a$	$53.58\ (34.89)_b$
VO2 Max	38.85 (9.70)	39.81 (6.68)	40.02 (8.53)

Note. Significant group differences, $p<.05$ are indicated by the different subscripts.

Multiple analyses of variance with one between-subjects factor (groups) was used to compare motivational style, and affect at the start of the exercise program between the three attendance based groups. The motivational styles were examined in one analysis as were each of the three types of affect assessed. The means and standard deviations are presented in Table 29.

Table 29

Between Groups Scores on Affect, Vitality and Motivational Style

	Drop-outs Mean (SD)	Non-adherers Mean (SD)	Adherers Mean (SD)
FS Before Exercise	1.67 (1.86)	2.22 (1.55)	2.42 (1.79)
FS After Exercise	2.66 (1.03)	3.15 (1.17)	3.18 (1.31)
PANAS Positive Before Exercise	3.27 (0.71)	2.75 (0.74)	3.01 (0.80)
PANAS Negative Before Exercise	$1.85\ (0.59)_a$	$1.37\ (0.37)_b$	$1.31\ (0.36)_b$
PANAS Positive After Exercise	3.62 (0.77)	3.46 (0.62)	3.61 (0.81)
PANAS Negative After Exercise	1.28 (0.32)	1.16 (0.25)	1.12 (0.23)
Vitality	4.29 (1.15)	4.82 (1.36)	4.97 (0.99)
BREQ - External Regulation	0.67 (0.76)	0.69 (0.70)	0.51 (0.64)
BREQ - Introjected Regulation	1.95 (1.06)	1.74 (1.17)	1.49 (1.08)
BREQ - Identified Regulation	3.07 (0.69)	2.91 (0.77)	3.24 (0.64)
BREQ - Intrinsic Regulation	2.48 (1.08)	2.64 (1.01)	2.9 (0.96)

Note. Significant group differences ($p<.05$) are indicated by different subscripts.

There was no multivariate difference between the three groups on the BREQ subscales at Time 1, $F(8,162) = 1.23$, $p = 0.28$ ($p > .05$), $Eta^2 = .06$. There was a multivariate difference in exercise related affect between groups at Time 1, $F(8,130) = 2.17$, $p = .03$. Tests of between subjects effects showed that only negative affect at the start of exercise distinguished between the groups $F(2,67) = 5.04$, $p < .05$, ($R^2 = .131$). Tukey's HSD post hoc test showed that the dropouts had significantly higher negative affect before exercise than the non-adherers and the adherers who were not different from

each other. Feelings experienced (FS) during exercise did not differentiate between the three groups. This was shown using a MANOVA of the FS, $F(4,134) = .331$, $p = .86$. In regards to vitality, an ANOVA showed that vitality did not differentiate between the groups, $F(2,85) = 2.48$, $p = .09$.

The final factor that differentiated between the groups was METS. An ANOVA, $F(2,85) = 3.71$, $p < .05$, $Eta^2 = .08$, showed that the adherers had the highest level of METS (mean = 53.58), the non-adherers had the second highest (mean = 39.24) and the dropouts had the lowest METS (mean = 34.75). This makes sense as the adherers exercised the most and the dropouts exercised the least throughout the study, therefore they would have the lowest METS scores. Tukey's HSD showed that the dropouts differed from the adherers, and the adherers differed from the non-adherers. However, the dropouts did not significantly differ from the non-adherers. The hypothesis that the motivational style would differentiate the attendance-based groups was not supported, as only pre-exercise negative affect and METS significantly distinguished between the groups.

Change in Motivational Style Over Time

To address the hypothesis that self-determined forms of motivation would increase, and less self-determined forms of motivation would decrease over time a doubly multivariate repeated measures MANOVA was conducted on the BREQ subscales over time. Scores on the BREQ at all three time points are reported in Table 30. Both time and BREQ sub-scales were treated as repeated measures. There was a mild interaction between time and the BREQ, $F(6,55) = 3.33$, $p < .01$, $Eta^2 = .267$. There were also main effects for time and the BREQ, $F(2,59) = 3.90$, $p < .03$, $Eta^2 = .03$, and $F(3,58) = 227.99$,

$p < .0001$, $Eta^2 = .92$ (see Figure 2). Identified and intrinsic motivation did not change significantly over time. The less self-determined forms of motivation, introjected and extrinsic regulation increased from Time 1 to Time 2, peaked at Time 2, and declined again to Time 3. Time 1 was not significantly different from Time 3. It is possible that the source of the interaction comes from the difference in the slope of change of introjected and extrinsic motivation from Time 1 to Time 2 and again from Time 2 to Time 3 because identified and intrinsic motivation apparently did not change over time. This hypothesis was partially supported as the more self-determined forms of motivation were found to increase only slightly over time and the less self-determined forms of motivation fluctuated over time.

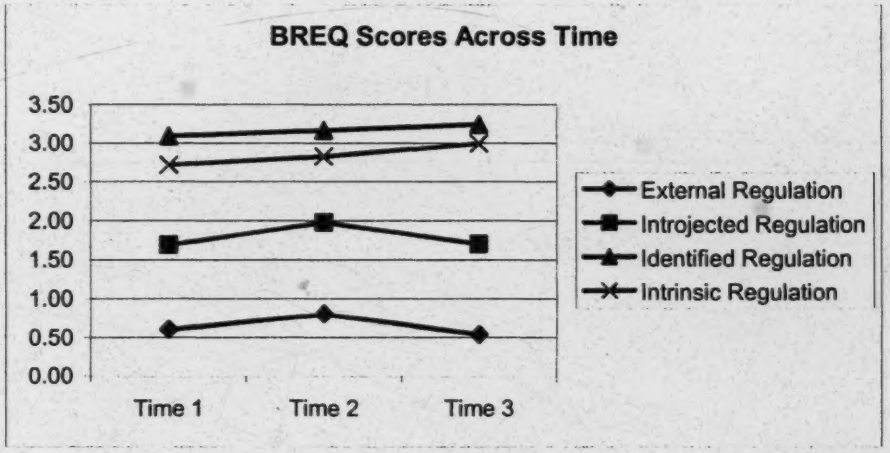
Table 30

BREQ - Regulation Style Across Three Time Points

	Time 1			Time 2			Time 3		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
External Regulation	87	0.61	0.69	66	0.81	0.83	66	0.54	0.61
Introjected Regulation	86	1.69	1.11	66	1.98	1.17	65	1.70	1.21
Identified Regulation	87	3.09	0.71	66	3.17	0.65	66	3.24	0.64
Intrinsic Regulation	87	2.72	1.02	66	2.83	0.96	66	3.00	0.86

Figure 4

BREQ Scores Across Time



Discussion

The overall purpose of this study was to determine the relationships between self-determination and exercise-related affect, furthermore, to examine the effect of these relationships on exercise adherence and dropout. The three variables; motivation style, affect, and exercise adherence, were examined in a variety of ways.

This study had four main purposes, three sub-purposes and two exploratory purposes. The first main purpose was to determine if attendance could be predicted at the three time points using self-determination. The second purpose was to determine if attendance could be predicted at the three time points using affect. The third purpose was to assess the direction of the relationships between motivation style and affect (more specifically between the BREQ and the PANAS, and the BREQ and the FS). The fourth purpose was to determine if affect mediated the relationship between regulation style and adherence.

The first sub-purpose was to determine if activity level could be predicted using the BREQ. The second sub-purpose was to examine the relationship between subjective vitality (a form of positive affect) and the BREQ at all three time points. The third sub-purpose was to determine the relationship between exercise intensity and affect during exercise.

The exploratory purpose was to identify the variables that distinguished the adherers, non-adherers and dropouts from each other. The pattern of motivation over time was also examined.

Predicting Attendance with Regulation Style

Very little support was found for the hypothesis that motivational style was related to attendance. Introjected regulation negatively predicted attendance at Time 2 only (program mid-point). Thus, participants who were exercising to satisfy external motives such as avoiding guilt or anxiety, or to increase pride (Ryan & Deci, 2000) were less likely to attend exercise sessions at this time. The fact that these relationships were only significant at Time 2 suggests that motivation levels might not be stable during an exercise program. At times during the exercise program where motivation was less self-determined, exercise attendance might be expected to drop off. This suggests that exercising to satisfy an external demand or to achieve a reward (Ryan & Deci, 2000) were unlikely to be associated with consistent exercise behavior in this sample. It has been shown that behaviors motivated by internal rather than external factors are more likely to lead to intentions (Wilson & Rodgers, 2004), which then lead to the performance of the behavior. The motivation to initiate an exercise program and sustain the exercise behavior might be different.

Predicting Attendance with Affect (PANAS)

In the exercise affect literature it is not known whether it is the pre-exercise, post-exercise, or during-exercise affect that is the most effective predictor of exercise adherence. There is a mixture of findings in the literature supporting some influence of affect experienced at each of these times (Steinberg et al., 1998). In this study, no strong relationships were observed between affect and exercise behavior. Therefore, the hypothesis that positive forms of affect would be related to higher levels of attendance was not supported. It would be interesting to repeat this portion of the study to determine if affect can predict exercise dropout in different contexts such as aerobic classes or sports teams.

Relationship Between Regulation Style and Affect

The relationship between the BREQ and the PANAS (before and after exercise), and the BREQ and the FS (during exercise) were assessed at all three time points. It was hypothesized that more self-determined forms of motivation would be related to higher levels of positive affect. In addition, less self-determined forms of motivation would be related to higher levels of negative affect. This hypothesis was supported. The relationship between the BREQ and PANAS (affect experienced before and after exercise) will be discussed first followed by the relationship between the BREQ and the FS (affect experienced during exercise).

Motivation Style with Affect Before and After Exercise

Support was found for the hypothesis that more self-determined forms of motivation would be related to positive affect, and less self-determined forms of motivation would be related to negative affect. Significant relationships emerged

between pre- and post-exercise affect and motivational style at all three time points. Pre-exercise negative affect was positively correlated with less self-determined motivation at the three time points. Post-exercise negative affect was also positively correlated with external and introjected regulation at Time 1, and Time 2. However, at Time 3, post-exercise negative affect was only positively correlated with external regulation showing that those who had less self-determined motives for exercise were more likely to experience negative affect before and after exercise. This finding is in agreement with self-determination theory as it states negative affect is associated with externally regulated behaviors, performed to satisfy an external demand or to achieve a reward, and introjected regulated behaviors, performed to avoid guilt and anxiety, or to increase pride. The present study, as well as others (Ryan & Deci, 2000; Biddle, et. al., 1999) have found that behaviors performed for these reasons have been linked to negative affect.

More self-regulated forms of motivation were correlated with positive affect only. At Time 1 post-exercise positive affect was positively correlated with identified and intrinsic regulation. At Time 2 this relationship was also observed and a new positive correlation emerged between pre-exercise positive affect and intrinsic regulation. At Time 3, all of these relationships were observed again and a new positive correlation between pre-exercise positive affect and identified regulation emerged. This shows that the relationship between post-exercise positive affect and the more self-determined forms of motivation were consistent over time. Pre-exercise positive affect was not associated with the more self-determined forms of motivation at the beginning of the study, however by the end it was related to self-determined forms. In terms of SDT, it seems that exercise behaviors which were internally motivated were more likely to be related to

positive affect, and behaviors which were externally motivated were more likely to be related to negative affect. This is consistent with previous research that has shown that more self-determined exercise regulations are positively related to exercise attitudes and affect (Wilson, et. al., 2003). Another study found self-determined forms of motivation for exercise to correlate positively, and less self-determined forms of motivation for exercise to correlate negatively with positive affect (Lutz, et. al., 2002). The findings from this study were slightly inconsistent with Lutz, et. al., because no significant negative correlations emerged and the self-determined forms of motivation were not significantly positively correlated with positive affect at all time points. This may be because the sample in this study was highly self-determined for exercise and were also quite active before enrolling in the study. Therefore they may have been less likely to experience exercise related negative affect. Other studies have offered explanations for why exercise produces feelings of positive affect. Exercise has commonly been shown to produce more positive mood enhancing effects after exercise (Sexton, et. al., 2001). This could be due to a variety of factors possibly including the feeling of accomplishment that comes with completing a workout, or an increase in endorphins due to the exercise (Klonoff, et. al., 1994), or stress release.

Motivation Style with Affect During Exercise

Partial support was found for the hypothesis that more self-determined forms of motivation would be related to positive affect, and less self-determined forms of motivation would be related to negative affect during exercise. The correlational analyses between the FS and the BREQ sub-scales at all three time points showed some significant relationships. At Time 1 and 2, significant negative correlations emerged

between introjected regulation and affect. Therefore, the more introjected regulation an individual reported the less positive their affect was during the session. This finding is congruent with SDT, as it proposes that behaviors which are less self-determined are more likely to be associated with negative feelings (Ryan & Deci, 2000).

Positive correlations were also observed between intrinsic regulation and positive affect. This positive relationship between intrinsic regulation and positive affect occurred at 60% of maximum heart rate and greater and was the strongest at Time 3. Also, the strongest correlations occurred at Time 3 at the highest heart rate intensities. This suggests that those who had more self-determined motivation for exercise experienced the highest positive affect at higher heart rate intensities. This is in agreement with SDT which suggests that intrinsically motivated behaviors are more likely to produce positive affective outcomes. Positive correlations also emerged between identified regulation and positive affect, but only at Time 1 and 3. At Time 3 this correlation was larger suggesting that over time the relationship between high intensity exercise and identified regulation got stronger. These results support that significant relationships between motivation style and affect do exist. This finding should be examined more in the future as these variables are not often combined in the literature.

Affect as a Mediator between Motivational Style and Attendance

The fourth purpose of the study was to determine if affect could mediate the relationship between regulation style and exercise adherence. Four separate analyses were performed according to the recommendations of Baron and Kenny (1986) to determine whether affect mediated the relationship between regulation style and exercise adherence. A significant relationship was not observed between affect and attendance,

therefore mediation could not be established. As this was the first known study to examine affect as a mediator between the BREQ and exercise adherence it would be useful to repeat this portion of the study to see if the same results occurred in other contexts or samples. The preliminary steps in this analysis revealed results that were in agreement with other studies in the exercise literature. Regulation style was also found to be related to affect which is consistent with other research (Lutz, et. al., 2002). These relationships should be examined in future studies as there are a lack of studies that examine affect as a mediator.

Sub-Purposes

Self-Determination as a Predictor of Physical Activity

The only significant predictor of physical activity represented as METS was intrinsic motivation, accounting for 24% of the variance at Time 1 only. Those who were most intrinsically motivated to exercise also reported engaging in more exercise prior to the start of the study. Other studies have reported the same finding (Frederick, Morrison & Manning, 1996). It is important to note that the METS score at Time 1 represented the general activity level of the participants, compared to Time 2 and 3 where the METS scores represented the activity level of the past four weeks. It should also be noted that regulation styles and METS are not static, both of these variables were found to change over time. At Time 1 intrinsic motivation predicted METS, this was a positive relationship. However, at Time 3 extrinsic motivation predicted METS, this was a negative relationship. This shows that the relationship between motivation style and activity level changes over time.

Relationship Between Motivation Style and Subjective Vitality

The correlations between identified and intrinsic regulation with vitality were quite strong at all time points. It was apparent that those who were more self-determined for physical activity had greater feelings of vitality. These findings provide additional support for the connection between self-determined motivation and positive feelings. This is consistent with past research (Ryan & Deci, 2000; Maltby & Day, 2001) and self-determination theory (Ryan & Deci, 2000).

Intensity and Affect During Exercise

In regards to the third sub-purpose to determine the relationship between intensity level and affect during exercise the hypothesis that affect would increase throughout the exercise session as intensity increased was partially supported. Generally, exercise affect during the session increased as heart rate increased from 50% to 70% of maximum. After this point, exercise affect began to decrease, especially at 85% of max heart rate where affect tended to be less positive. This finding is consistent with Hall et. al. (2002), who found that high intensity exercise led to less positive affective states. Affective responses to exercise are thought to have a corresponding physiological origin (Tuson & Sinyor, 1993). In this study it seems that high heart rate intensities were associated with less positive affect and that lower heart rate intensities were associated with more positive affect. This finding might be important to consider when untrained individuals work out at intensities that are too difficult for them. It may produce negative affect and in turn lead to being discouraged from exercising. Other studies, (e.g., Gaynor, et. al., 1994) have also reported a relationship between negative affect and relatively difficult exercise intensities.

Exploratory Purposes

Variables that Distinguish Between Adherers, Non-adherers, and Dropouts

The first exploratory purpose was to identify the variables that distinguished the adherers, non-adherers and dropouts from each other. Two variables were found to significantly distinguish between the attendance-based groups.

Regulation style did not differentiate between the groups. These findings are inconsistent with SDT, which postulates that those who are more self-determined for exercise will be more likely to adhere (Ryan & Deci, 2000). Since the participants in this study were already quite highly active, the results cannot be generalized to their overall activity levels and possibly only reflect their involvement in the activity program associated with the study.

In regard to the pre- and post-exercise scores using the PANAS, only the pre-exercise negative affect scores significantly differentiated between the three groups. The dropouts experienced significantly higher levels of pre-exercise negative affect than the non-adherers and the adherers. Thus, the more negative feelings someone experiences prior to exercising, the more likely it is that they will not continue with the program. The pre-exercise positive PANAS scores and the post-exercise positive and negative PANAS scores did not significantly differentiate the three groups. From an intervention standpoint, this is an interesting finding. It might be possible to produce more positive pre-exercise affect by giving participants something to look forward to. This could potentially reduce the risk of drop out associated with negative pre-exercise affect.

The feelings experienced during exercise described by the FS also did not differentiate between the groups. These findings show that pre-exercise negative affect

may be most critical when trying to differentiate dropouts from other types of exercisers. Other studies have had similar findings, Hall, et. al., (2002) found negative affect to be related to decreased adherence to exercise. Also, SDT states that negative affect is related to non-self determined forms of motivation, and these forms of motivation lead to non-completion of the behavior (Ryan & Deci, 2000).

Vitality, which has been found to contribute to a sense of well-being as well as aspects of SDT (Ryan & La Guardia, 2000) did not differentiate the attendance-based groups. However, a link between vitality and exercise adherence has been found in previous research (Maltby & Day, 2001).

Dropouts were most likely to have the lowest METS and pre-exercise negative affect. As negative affect distinguished the drop-outs from the adherers and non-adherers exercise professionals may be able to use this information to create strategies to decrease pre-exercise negative affect in exercisers. Also, in this study, negative affect was associated with less self-determined forms of motivation, although not specifically in the drop-outs. The combined influence of motivation and affect might be more pronounced in a less active sample. Future researchers should consider this when selecting a study sample.

Motivation Style Over Time

The second exploratory purpose of the study was to examine the patterns of change in the BREQ scores over time. The more self-determined forms of motivation were found to increase slightly over time and the less self-determined forms of motivation fluctuated over time. This is an interesting finding as it suggests that as people continue to exercise their motivation is not static. This has implications for the

promotion of exercise behaviors. It might be necessary to have sustained efforts to support self-determination if less self-determined motives are more susceptible to fluctuation than more self-determined motives, as suggested in this study.

Conclusions Regarding Affect

Affect was assessed at different times relative to exercise. These were general subjective vitality, which was not specific to exercise, as well as affect immediately prior to exercise, during exercise and following exercise. There might be more variability in the measures that assessed affect at the specific moments (e.g., before exercise) individuals may be influenced by other events that occurred that day. This would make these measures vary on a day to day basis. However, vitality was probably more constant over time. This may be why we see fluctuations over time in the relationships with affect assessed with the PANAS and the FS with the other variables compared to the relationships observed with vitality. Regulation style seems to be most reliably be related to the more enduring indices of well-being, such as vitality. It appears that general forms of positive affect or well-being are more strongly related to overall motivation than the feelings that are experienced on a day to day basis. All three of the affect measures highlighted a pattern of relationship with SDT. These relationships generally showed that more self-determined motivation for exercise was positively related to positive affect and less self-determined motivation for exercise was positively related to negative affect. These results are important because they highlight that more self-determined forms of motivation are consistently related to more positive feelings. This information could be used in fitness and exercise settings. It would be useful to encourage and counsel people to exercise based on their internal motives for exercise rather than focus on their external

motives. If individual's self-determined forms of motivation become their main source of motivation for exercise they may be more likely to experience positive feelings before, during and after exercise, as well as in general. This may in-turn lead to an increase in their exercise behaviors.

Conclusion

Overall, there were several interesting relationships observed among affect, motivational style and behavior. There were minimal relationships observed between affect and behavior. The relationship between motivation style and behavior was not observed to be mediated by affect. However, it was evident that regulation style independently related to behavior expressed as METS. These findings are similar to other research in this area (Lutz, et. al., 2002; Frederick, et. al., 1996). Those with higher levels of self-determination for exercise were more likely to experience positive affect. However, it was the absence of negative affect before exercising, rather than feelings of positive affect during exercise, that were more related to adherence. The three attendance based groups were significantly differentiated by pre-exercise negative affect and METS scores, again pointing to the potential importance of reducing negative affect rather than focusing on increasing positive affect. The findings show that there are differences between those who exercise regularly, those who do not, and those who drop-out.

Limitations

This study included a group of young women who were quite active and healthy. As the general population is not typically as active as the participants in the study this was not a representative sample, however some interesting findings emerged. For

instance, despite the fact that this sample was already active, activity levels increased throughout the study.

There were some other significant limitations in this study. This was not an experimental design. Therefore, cause and effect relationships could not be determined. Also, even though the study did have a longitudinal component it was only 11-weeks, consequently, long-term effects could not be determined past the end of the prescribed exercise program.

There were some factors that could not be controlled. For example, during the supervised workouts it is possible that some of the participants felt nervous or stressed and as a result did not work at their full potential or reported inaccurate affective states. Similarly, participants might have responded to questionnaire items in a socially desirable manner. In addition, experimenter demand may have influenced the adherence of the participants as well as other variables such as how the participants reported their affect scores. The participants may have responded in a manner they thought the experimenter would prefer. This was most likely to occur at the exercise sessions as the participant responded directly to the experimenter rather than on paper.

Some factors could have affected the internal validity of the study. There were multiple tests which could have led the participants to respond similarly on these measures as time went on. Experimenter effects were a concern as the experimenter worked closely with the participants at times throughout the study including exercise tests, exercise instructional sessions, and the three exercise testing sessions where affect was assessed. Some participants may have been influenced by the fact that they were participating in a study. This could have made the participants feel accountable and in

turn attend more exercise sessions than they might have under other circumstances. It is evident that at Time 2 there was more negative affect reported. This may be because the majority of the sample comprised students and Time 2 occurred at exam time resulting in a more generally negative affect.

The sample was a convenience sample obtained at one university campus. Therefore the participants were not representative of the general population. Also, college-age samples tend to exhibit a high level of autonomous regulation for exercise (Lutz, et. al., 2002).

It was also a snowball sample, meaning many of the participants invited friends to participate in the study. This could have led to similarities in the respondent pool as well as participants responding to questionnaires in a similar manner as their friends. In addition, participants may have been influenced by their friends regarding when or how often to exercise, or even to drop-out of the study. Despite these limitations the study did provide some useful information regarding the relationship between affect and self-determination.

Assumptions

In order to conduct this type of research, certain assumptions must be made. It was assumed that different types of motivation exist. Also, people are believed to be capable of understanding these different types of motivation and reporting about them. In addition, different affective states were assumed to exist. Participants should be able to differentiate between these different states and report about them as well. The different motivation styles and affective states are measurable. The measures of motivational style and affect were assumed to be valid and reliable.

Assumptions must be made about certain issues that could not be controlled for. It was expected that all participants completed the questionnaires honestly and correctly. Additionally, it was assumed that the participants complied with the researcher's instructions in regard to the protocols of the study. Some steps were taken to decrease the chances of problems regarding these issues from occurring. The researcher made the participants feel as comfortable as possible and encouraged them to respond to the questionnaires freely and honestly. Also, the researcher made sure to provide very clear instructions ahead of time, and also provide reminders about the requirements of the participants. Making the participants feel comfortable hopefully decreased the chances of obtaining inaccurate data and helped the study to run more smoothly.

Future Directions

Although this study has highlighted some interesting findings, much more research in this area remains to be done. Motivation style and affect should continue to be combined in research as many studies have reported conflicting findings and patterns regarding this relationship. Dropout should be examined further as the literature on predictors of dropout is very limited. Also, affect should be examined with additional physiological variables other than heart rate, such as respiration, blood sugar levels, or actual oxygen consumption. The research in this area is growing but is still quite limited and some conflicting findings exist. Conflicting findings are most common in the area of affect research. There still remain questions about when affect should be assessed, such as before, after, and during the workout. Further studies should also be conducted to determine if affect could be a mediator between motivation style and adherence or dropout from exercise programs. In order to make results more generalizable, further

studies could be done with larger and different populations that include both sexes, such as beginners to exercise, individuals of varied fitness levels, and different age groups. Different exercise programs should also be looked at to see if different types of exercise produce different levels of affect.

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Appendix A

Behavioral Regulation in Exercise Questionnaire (BREQ)

(Mullan, Markland, & Ingledew, 1997)

For the questions below, exercise means engaging in activity for 20-30 minutes, four times per week, at a moderate intensity. Please respond how true **FOR YOU** each of the following statements are:

	Not true	Sometimes true	Moderately true	Often true	Very true
I feel like a failure when I haven't exercised in a while	0	1	2	3	4
I don't see the point in exercising	0	1	2	3	4
I get restless if I don't exercise regularly	0	1	2	3	4
I think it is important to make the effort to exercise regularly	0	1	2	3	4
I find my exercise a pleasurable activity	0	1	2	3	4
It's important to me to exercise regularly	0	1	2	3	4
I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
I feel under pressure from my friends/family to exercise	0	1	2	3	4
I exercise because it is fun	0	1	2	3	4
I exercise because other people say I should	0	1	2	3	4
I feel ashamed when I miss an exercise session	0	1	2	3	4
I exercise because others will not be pleased with me if I don't	0	1	2	3	4
I don't see why I should have to exercise	0	1	2	3	4
I enjoy my exercise sessions	0	1	2	3	4
I think exercising is a waste of time	0	1	2	3	4
I feel guilty when I don't exercise	0	1	2	3	4
I take part in exercise because my friends/family/spouse say I should	0	1	2	3	4
I can't see why I should bother to exercise	0	1	2	3	4
value the benefits of exercise	0	1	2	3	4

Appendix B
Positive Affect Negative Affect Scale (PANAS)
(Watson, Clark, & Tellegen, 1988)

By circling a number on the scale below each of the following items, please indicate the degree to which you are experiencing each feeling *NOW*, at this point in time, ***AFTER exercising***.

I FEEL.....

	Very Slightly or Not at all	A Little	Moderately	Quite a bit	Extremely
Alert	1	2	3	4	5
Inspired	1	2	3	4	5
Determined	1	2	3	4	5
Enthusiastic	1	2	3	4	5
Proud	1	2	3	4	5
Distressed	1	2	3	4	5
Upset	1	2	3	4	5
Guilty	1	2	3	4	5
Hostile	1	2	3	4	5
Afraid	1	2	3	4	5

Appendix C

Feeling Scale (FS)
(Hardy & Rejeski, 1989)

How do you feel right now?

+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5
Very Good		Good		Fairly Good	Neutral	Fairly Bad		Bad		Very Bad

Appendix D

Godin Leisure Time Exercise Questionnaire (GLTEQ)
(Godin & Shephard, 1985)

1. Considering a **7-day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your **free time** (write in each square the appropriate number).

TIMES PER WEEK

a) **Strenuous Exercise** ***(Heart beats rapidly)***
(i.e. running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller-skating, vigorous swimming, vigorous long distance bicycling) ☐

b) **Moderate Exercise** ***(Not exhausting)***
(i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing) ☐

c) **Mild Exercise** ***(Minimal effort)***
(i.e. yoga, archery, fishing from the riverbank, bowling, horseshoes, golf, snowmobiling, easy walking) ☐

2. Consider a **7-day period** (a week), during your **leisure-time** how often do you engage in any regular activity long enough to **work up a sweat** (heart beats rapidly)?

1. OFTEN ◯ 2. SOMETIMES ◯ 3. NEVER/RARELY ◯

Total METS per week = (9 * Strenuous) + (5 * Moderate) + (3 * Light)

Appendix E

Subjective Vitality Scale
(Ryan & Frederick, 1997)

1. I feel alive and vital

Not at all						Very True
1	2	3	4	5	6	7

2. I don't feel very energetic

Not at all						Very True
1	2	3	4	5	6	7

3. Sometimes I am so alive I just want to burst

Not at all						Very True
1	2	3	4	5	6	7

4. I have energy and spirit

Not at all						Very True
1	2	3	4	5	6	7

5. I look forward to each new day

Not at all						Very True
1	2	3	4	5	6	7

6. I nearly always feel awake and alert

Not at all						Very True
1	2	3	4	5	6	7

7. I feel energized

Not at all						Very True
1	2	3	4	5	6	7

Appendix F
Attendance Sheets

		4-Dec	5-Dec	6-Dec	7-Dec	8-Dec	9-Dec	10-Dec
First Name	Last Name							
First Name	Last Name							
First Name	Last Name							

Appendix G

Workout Log

Week 9: Nov 28 - Dec 4

	WORK OUT #1						WORK OUT #2						WORK OUT #3					
	1		2		3		1		2		3		1		2		3	
	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt
chest press																		
leg press																		
lat pull down																		
hamstring curls																		
shoulder press																		
bicep curl																		
tricep extension																		
abdominals																		
cardio																		
comments:																		

Week 10: December 5 - 11

	WORK OUT #1						WORK OUT #2						WORK OUT #3					
	1		2		3		1		2		3		1		2		3	
	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt	rep	wt
chest press																		
leg press																		
lat pull down																		
hamstring curls																		
shoulder press																		
bicep curl																		
tricep extension																		
abdominals																		
cardio																		
comments:																		

Appendix H

Correlation Matrix for Attendance and Regulation Style at Time 1, 2 and 3

Correlation Matrix for Attendance and Regulation Style at Time 1

	Regulation Style				
	1	2	3	4	5
1 Attendance					
2 External Regulation	-0.1				
3 Introjected Regulation	-0.17	0.15			
4 Identified Regulation	0.12	-0.04	0.29		
5 Intrinsic Regulation	0.17	-0.13	0.05	0.59	

Correlation Matrix for Attendance and Regulation Style at Time 2

	Regulation Style				
	1	2	3	4	5
1 Attendance					
2 External Regulation	0.03				
3 Introjected Regulation	-0.29	0.43			
4 Identified Regulation	0.17	0.09	0.2		
5 Intrinsic Regulation	0.27	-0.22	-0.15	0.66	

Correlation Matrix for Attendance and Regulation Style at Time 3

	Regulation Style				
	1	2	3	4	5
1 Attendance					
2 External Regulation	-0.05				
3 Introjected Regulation	-0.24	0.57			
4 Identified Regulation	0.03	0.21	0.21		
5 Intrinsic Regulation	0.16	-0.06	0.02	0.7	

Appendix I

Correlation Matrix for Attendance and Pre and Post Exercise Affect at Time 1, 2 and 3

Correlation Matrix for Attendance and Pre and Post Exercise Affect at Time 1

	Panas				
	1	2	3	4	5
1 Attendance					
2 Start Panas Positive	0.03				
3 Start Panas Negative	-0.3	-0.25			
4 End Panas Positive	0.05	0.7	-0.22		
5 End Panas Negative	-0.17	-0.06	0.69	-0.16	

Correlation Matrix for Attendance and Pre and Post Exercise Affect at Time 2

	Panas				
	1	2	3	4	5
1 Attendance					
2 Start Panas Positive	0.08				
3 Start Panas Negative	-0.13	-0.12			
4 End Panas Positive	0.17	0.74	-0.09		
5 End Panas Negative	-0.18	-0.18	0.83	-0.15	

Correlation Matrix for Attendance and Pre and Post Exercise Affect at Time 3

		Panas			
	1	2	3	4	5
1 Attendance					
2 Start Panas Positive	0.14				
3 Start Panas Negative	-0.14	-0.1			
4 End Panas Positive	0.25	0.74	-0.17		
5 End Panas Negative	-0.2	0.08	0.73	-0.06	

Appendix J

Extreme Values

Variable	Highest Extreme Value	Lowest Extreme Value
Total sessions attended	28	0
External regulation	3	0
Introjected regulation	4	0
Identified regulation	4	1.2
Intrinsic regulation	4	0
Pre-exercise positive affect	5	1
Pre-exercise negative affect	2.5	1
Post-exercise positive affect	5	1.7
Post-exercise negative affect	2	1